Space Weather Technical Forecast

Issued on Friday 22 November 2024 at 13:20 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Current S1 Minor Radiation Storm slowly easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low during the past 24 hours, with only C-class flares observed. The largest of which was a C9.0 at 22/0344 UTC from AR3901.

There are currently ten sunspot regions on the disc. The main regions on the disc at present includes AR3901 in the southeast, which comprises several leading spots, with small trailing spots and pores. The newly numbered region, AR3903 in the southwest appears to have continued to develop, previously a Bxi, but with noticeable umbra developing on both the leading and trailing spots and has been upgraded to a Dsi/beta. A newly numbered region AR3905 is also beginning to appear from around the southeastern limb, which given its location is currently difficult to analysis, but appears to show potential magnetic complexity. The majority of the remaining groups are simple and small with little magnetic complexity.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE have seen fairly steady slow to slightly elevated regime, with solar wind speeds 370-410km/s. The solar wind density near average or just below. The Interplanetary Magnetic Field (IMF), Bt, was weak to moderate, peaking at a Bt of 10nT at 21/1333 UTC. The north-south component generally weak but variable, ranging between +8 and -7nT. The phi angle mainly negative (towards the sun). Quiet to Unsettled geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 rose quickly from 21/1820 UTC following the large far-sided CME. The greater than 10 MeV proton flux briefly reaching S2 Moderate Radiation Storm levels, with a peak value of 125 pfu at 22/0355 UTC, before slowly declining but remains above the S1 Minor Radiation Storm threshold. The 100 MeV proton level reached a peak value of 7 pfu at 21/2010 UTC, but has since decreased well below the 1 pfu .

High energy electron flux (greater than 2MeV) observed by GOES16 was mainly at Normal Background levels. The associated 24-hour fluence remained below the Active threshold with a falling then level tendency, and the 24-hour integrated flux observed at 22/0001UTC was 1.32e6.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of isolated M-class flares.

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Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Geomagnetic activity is expected to be dominated by potential solar wind HSS enhancement, with the potential for increases in the solar wind to slightly-enhanced or enhanced levels, 450-500km/s, at times during the period.

Generally Quiet to Unsettled (Kp1-3) conditions expected, with a chance of Active (Kp4) intervals at times and a slight chance of G1/Minor Storm intervals should we see any more significant connection with a CIR/HSS.

Energetic Particles / Solar Radiation: The ongoing S1/Minor Solar Radiation storm is expected to continue through Day 1 (22 Nov) and likely into Day 2 (23 Nov) following recent enhancement. Proton flux levels are likely to take a few days to recover back to background levels from this event.

High energy electron flux is likely to remain generally background. The associated fluence is expected to remain below the Active (1e8 integrated flux) threshold.

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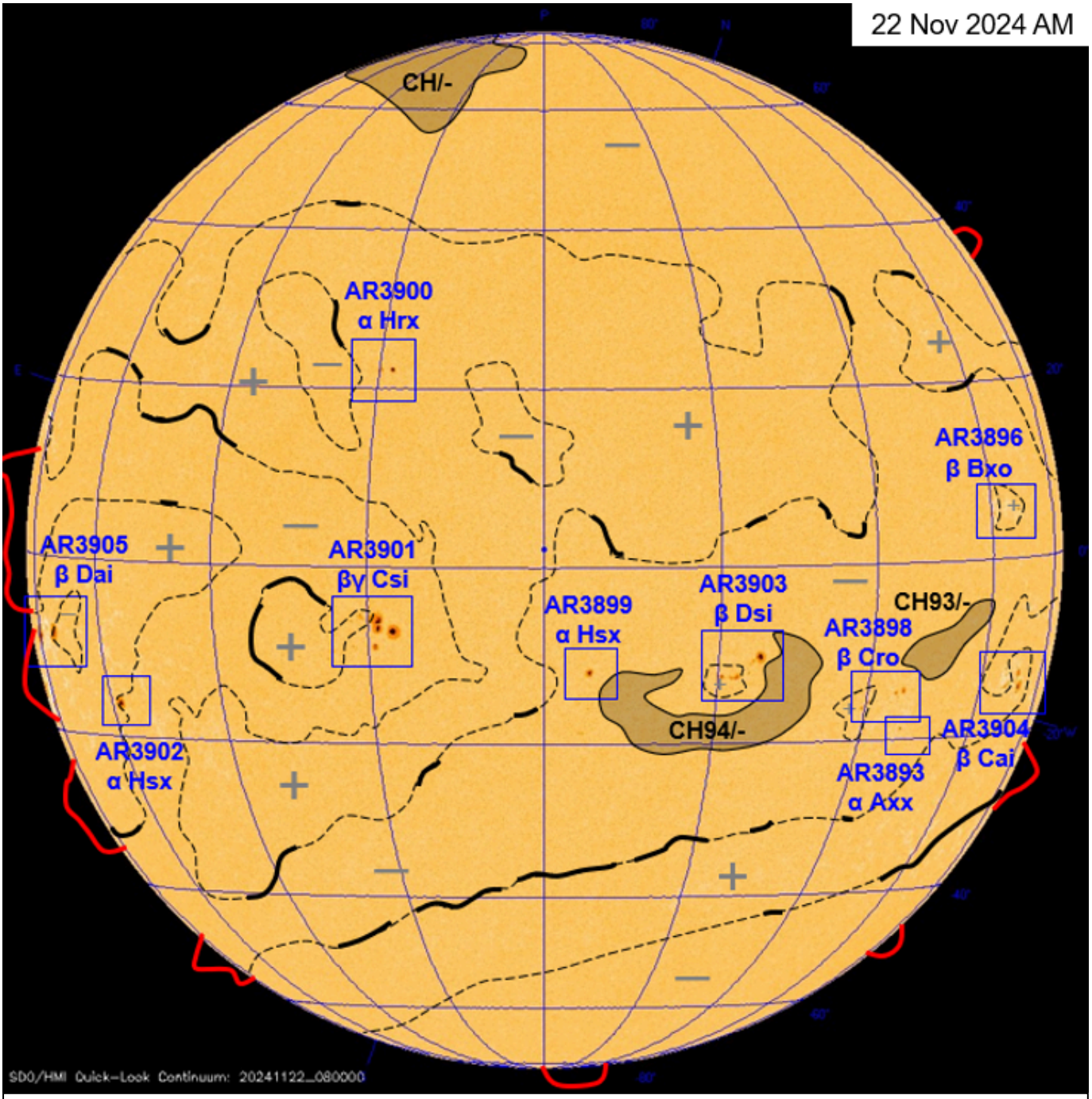
Figure 1: Solar Synoptic Map Valid 22/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs in the forecast. A filament eruption from the southeast disc at 21/0100UTC has been modeled and assessments show no effect at Earth.

Geomagnetic activity is therefore expected to be dominated by potential solar wind enhancement, firstly from CH93- and subsequently CH94-. Both of these features now appearing quite tenuous in imagery (e.g. AIA211) but there remain the potential for increases in the solar wind to slightly-enhanced or enhanced levels, 450-500km/s, during the period. Confidence is reduced due to errors in MOSWOC ENLIL output, which continues to present a much stronger and ongoing connection to a coronal hole than we are experiencing, with current output viewed as low confidence and not preferred.

Generally Quiet to Unsettled (Kp1-3) conditions expected, with a chance of Active (Kp4) intervals at times and a slight chance of G1/Minor Storm intervals should we see any more significant connection with a CIR/HSS.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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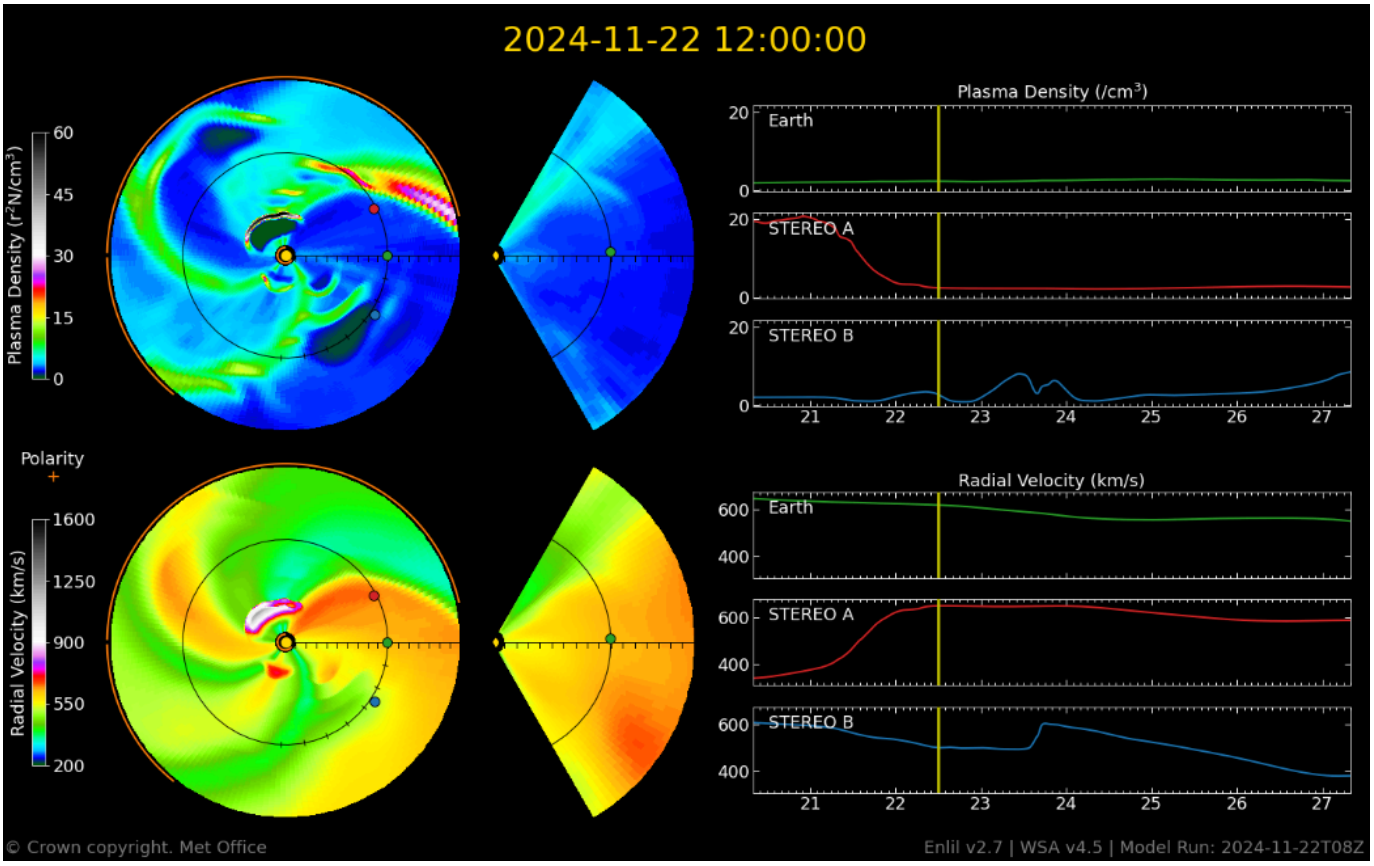
Figure 2: Latest MOSWOC ENLIL output, verifying poorly and not preferred.



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Radio Blackouts - X-Ray Flares

There are currently ten numbered sunspot regions on the disc with this number having increased over recent days with a steadily increasing Solar Flux (sfu) observed. These regions have so far remained generally small and simple however, with AR3901 in the southeast the most magnetically complex, active and largest region. This region comprising several symmetric penumbral leading spots, some of which have proliferated and migrated west in the period, with small trailing spots and pores.

Significant magnetic looping over the eastern limb and recurrence suggests that there are further spots to rotate onto the Earth-facing disc through the period. The first of which are becoming visible on the east limb and likely increasingly present the bulk of flare risk , although given the location they will remain difficult to analysis for a time. For now flare risk is kept consistent through the period pending further analysis and developments.

Low to Moderate activity is expected, with a chance of isolated Moderate flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	40	40	40	40
Very Active	R3-R5 (X Class)	No	1	1	1	1

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Solar Radiation Storms (High Energy Protons)

The ongoing S1/Minor Solar Radiation storm is expected to continue through Day 1 (22 Nov) and likely into Day 2 (23 Nov) following on from the recent large CME from around the western limb, possibly from Ex-AR3889, with Proton flux levels likely to take a few days to recover back to background levels from this event. A chance of S1/Minor Solar radiation storms by the end of the period as the remainder of the Earth-facing disc is largely unipolar or simple bipolar groups, and do not add any appreciable risk to the daily probabilities of Proton enhancement.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	100	70	40	10
Very Active	**≥ S3 ***	No	10	5	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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Figure 3: LASCO 3 showing Proton swarms (speckled dots) following a CME from around the west limb.

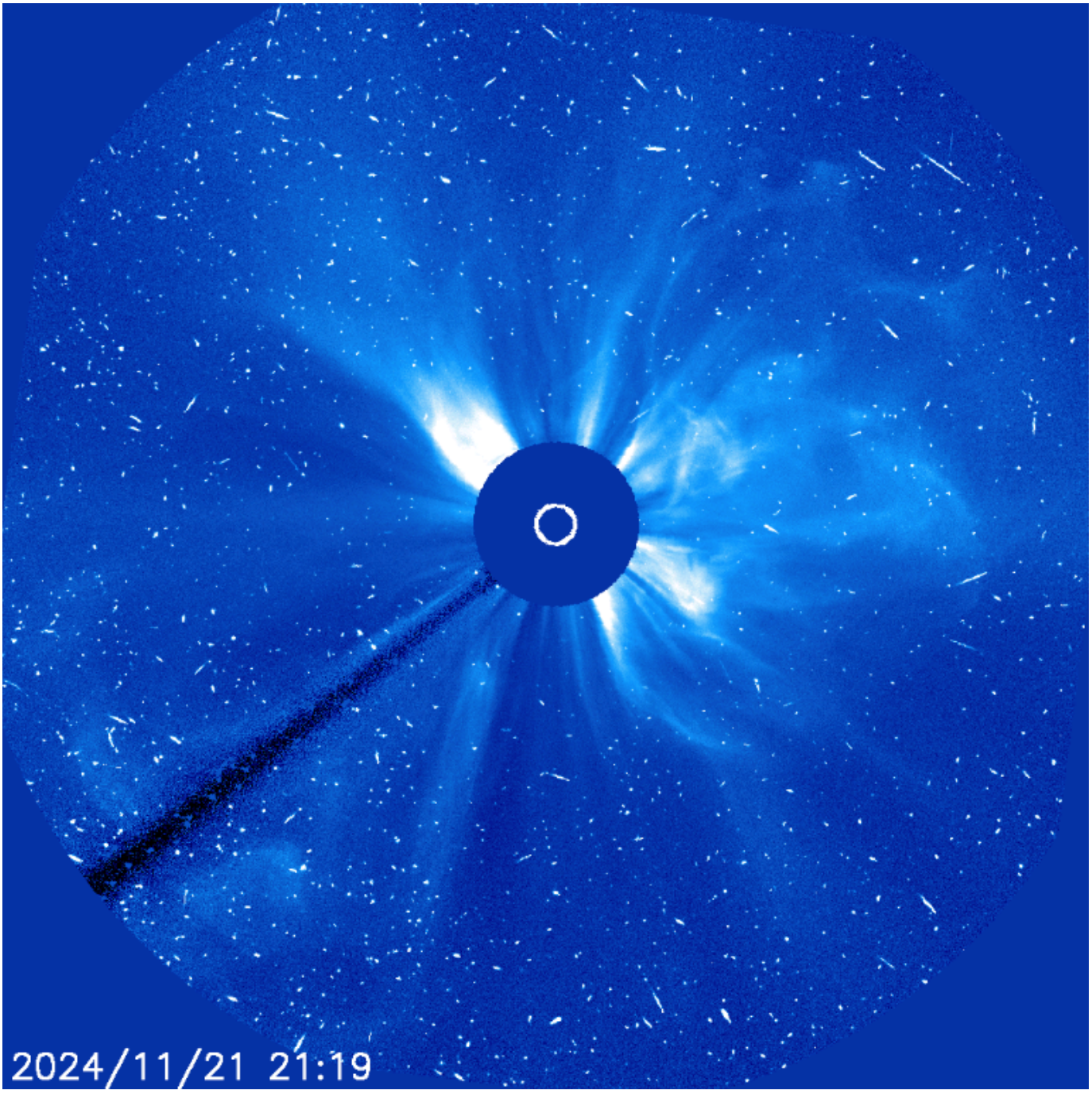

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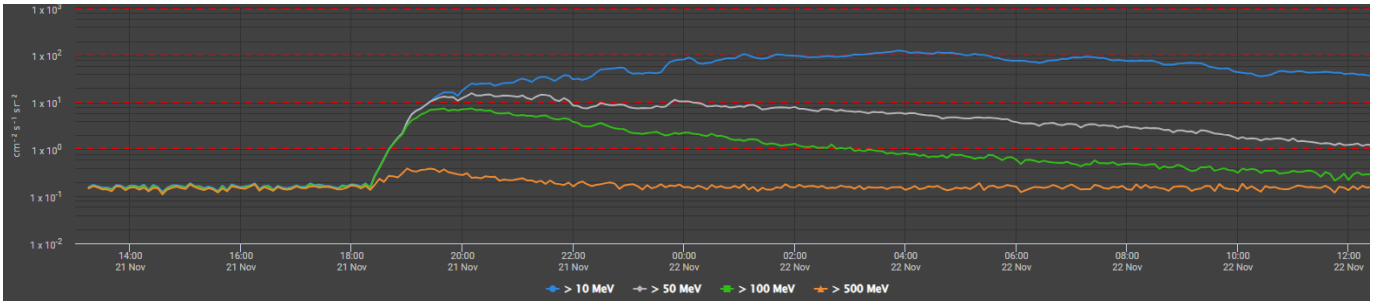
Figure 4: Latest 24hr GOES18 Proton Flux trace.



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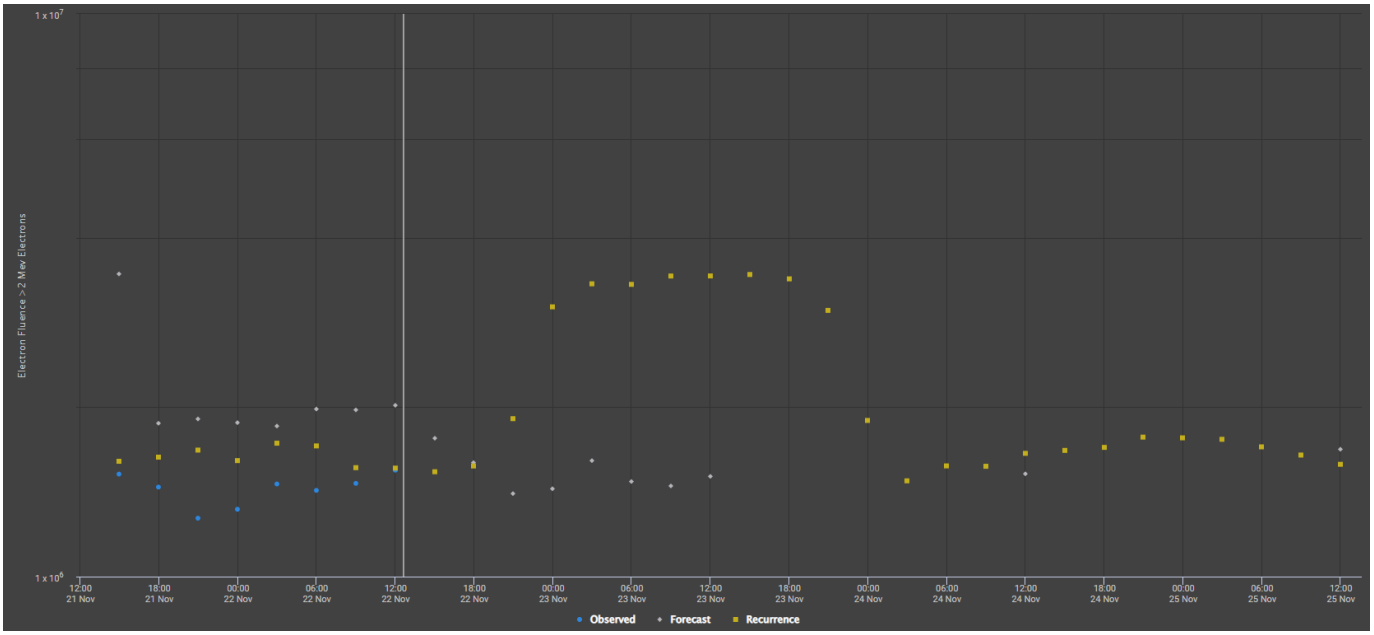
High Energy Electrons (≥ 2MeV)

Electron flux levels at GEO have been at Background levels and are expected to generally remain so. Electrons may temporarily increase to moderate or even diurnally high levels as the Van Allen belt expands back to the location of GEO at times during the period but no prolonged enhancement is expected with no persistent feature on the disc having resulted in Active fluence. MOSWOC REFM output viewed as providing reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: Latest MOSWOC REFM output.



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